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(54) A method and printing machine for printing a material web

(57) For the purpose of printing a material web that passes through between a printing cylinder 1 and an impression cylinder 2, dots of printing ink are produced on the printing cylinder along successive generators in the zone of the roller gap formed with the impression cylinder; according to the raster of the desired print image. These dots depict the rastered print image on the material web.

Figure 1

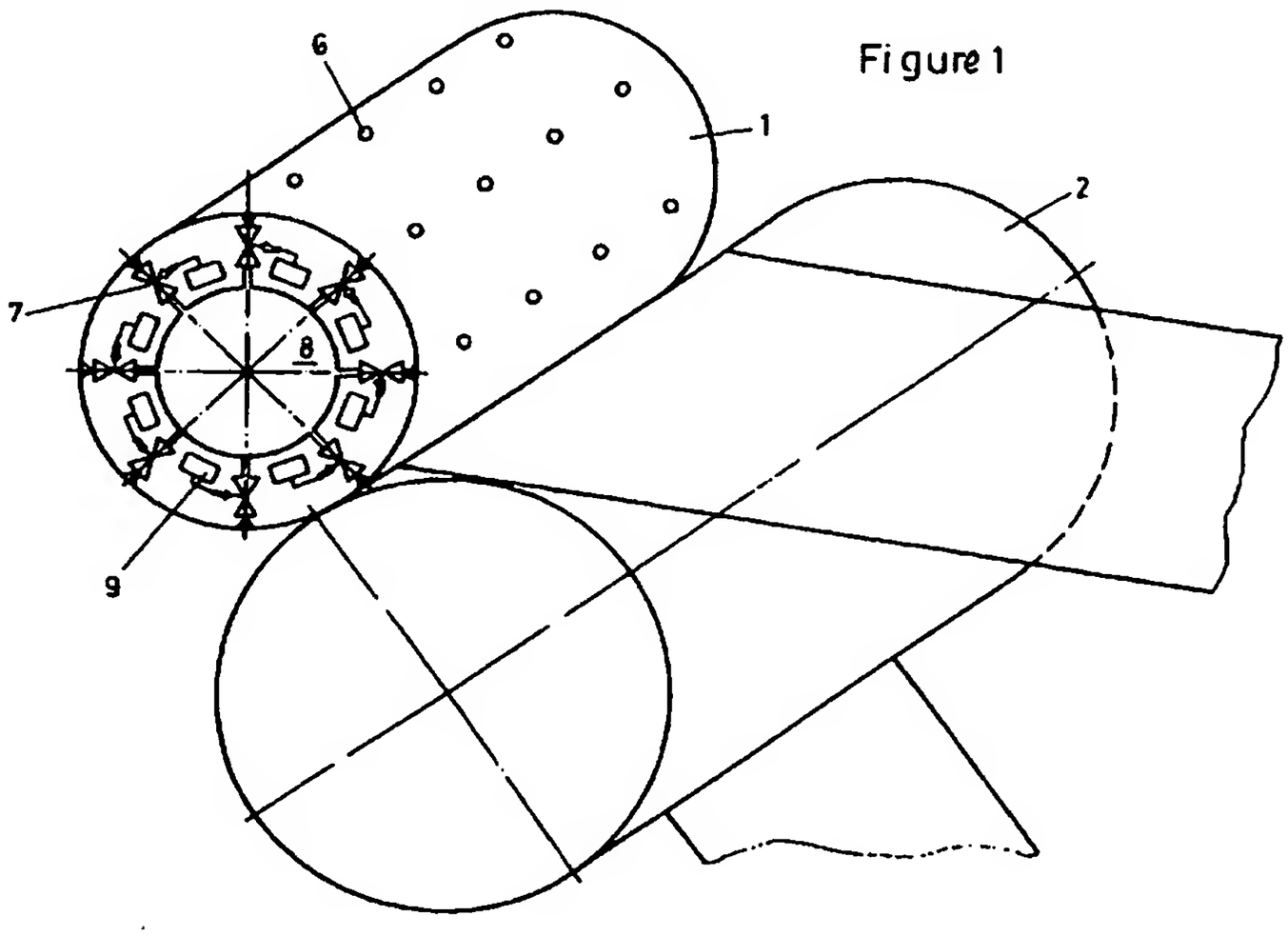

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Figure 1

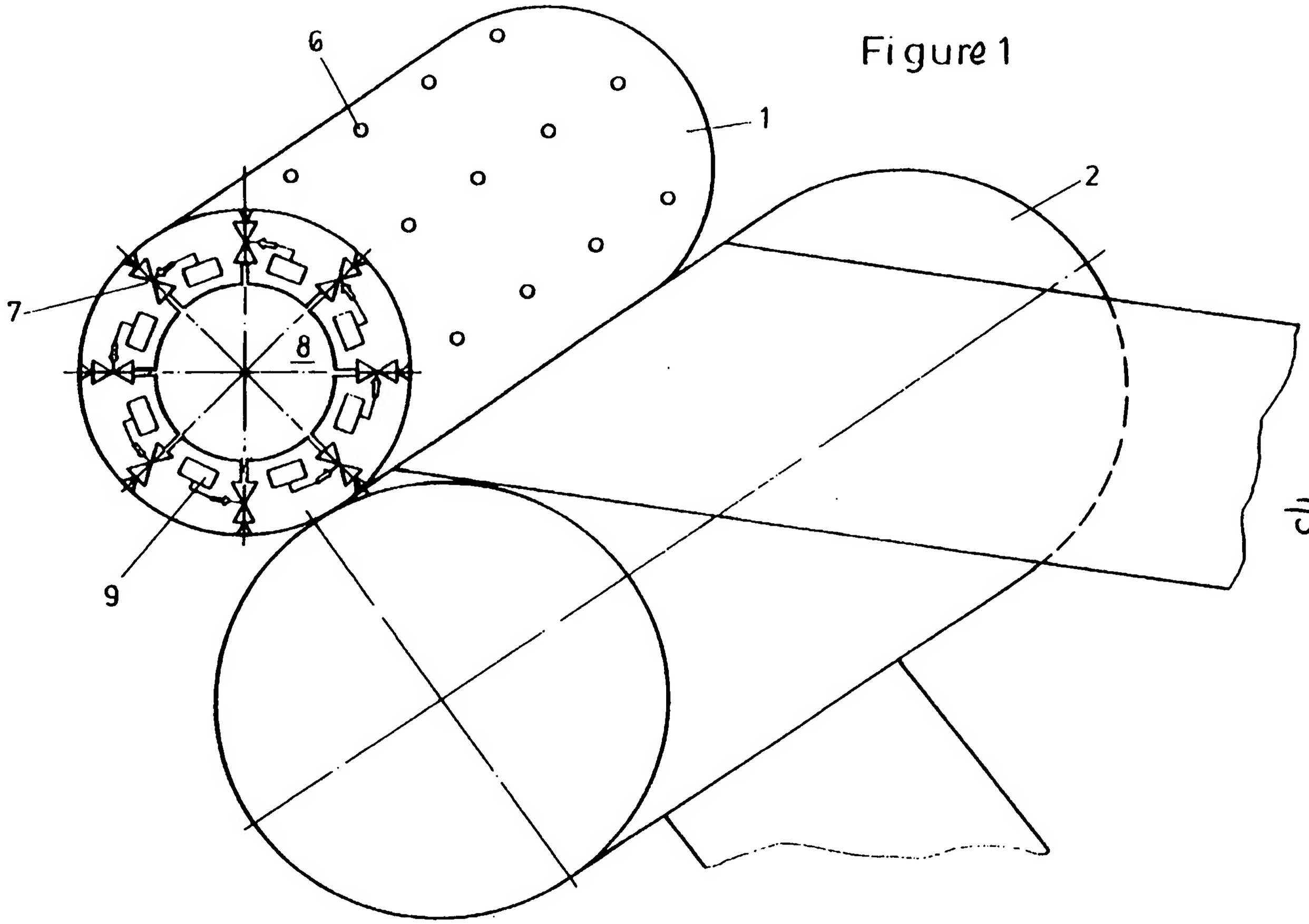
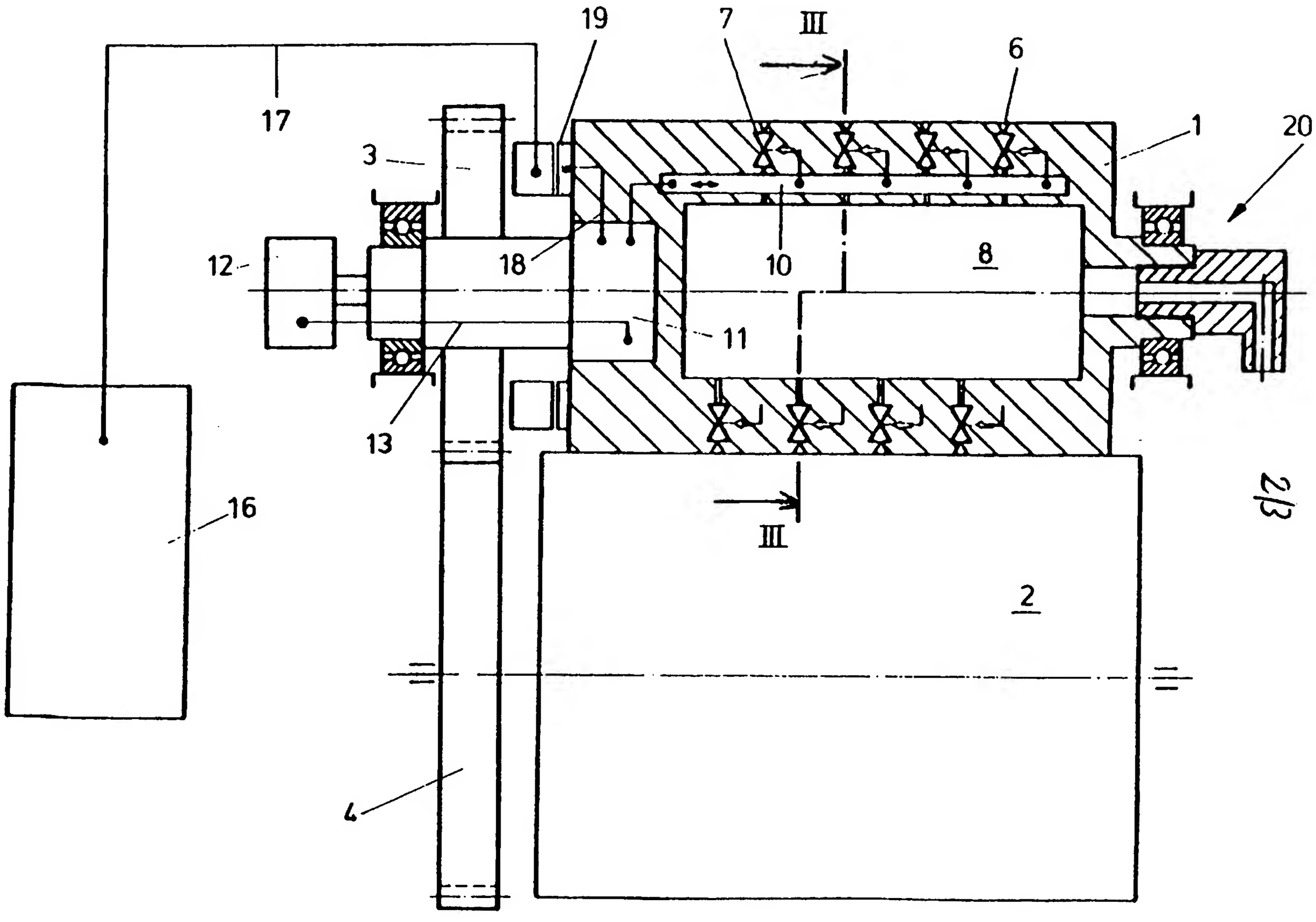


Figure 2



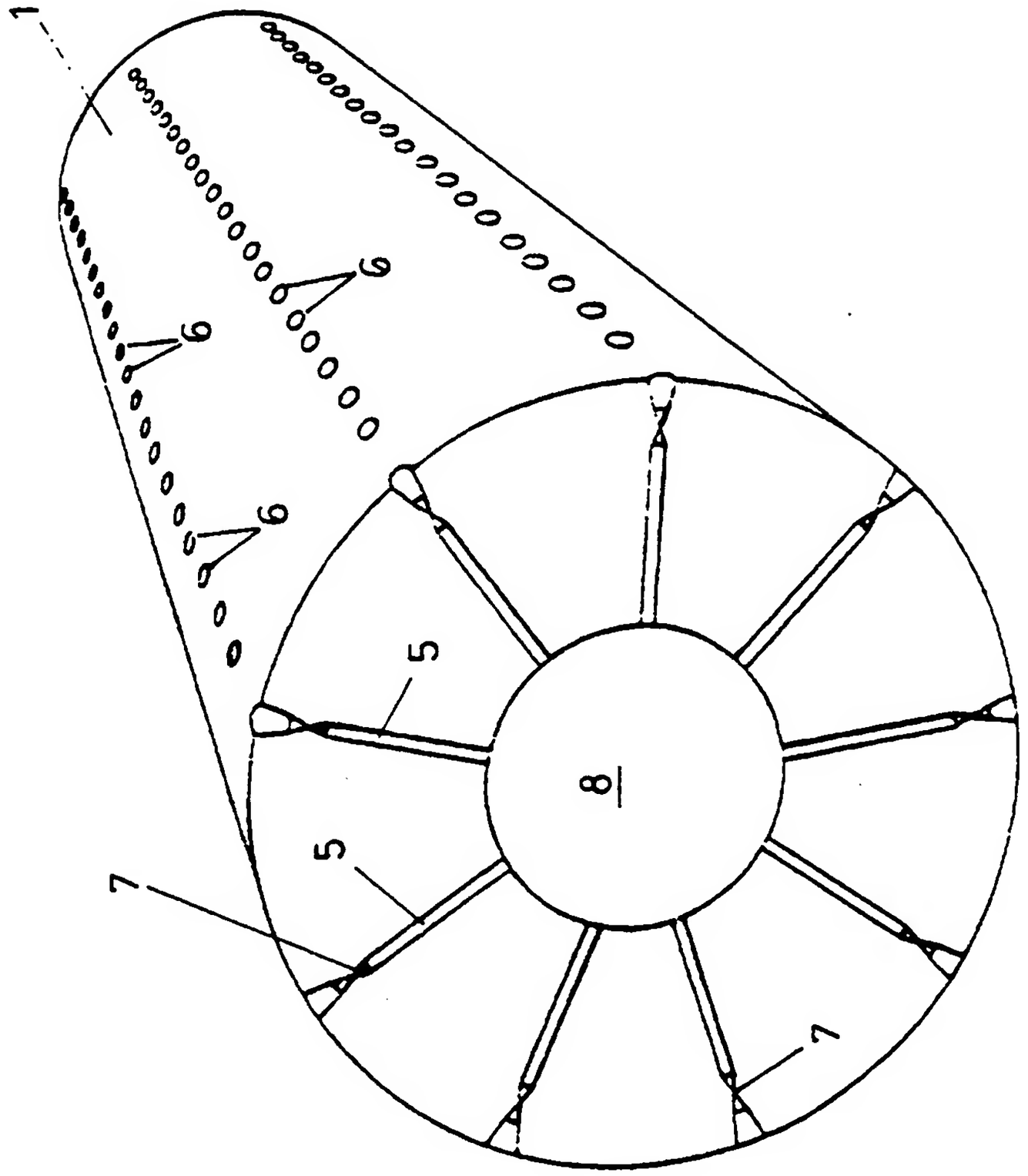


Figure 3

A METHOD AND PRINTING MACHINE FOR PRINTING A MATERIAL WEB

The invention concerns a method for printing a material web which runs through between a printing cylinder and an impression cylinder, and a printing machine for operating this method.

In conventional printing machines, the printing cylinder is provided with printing masters such as stereotypes or printing formes which are inked by the inking or application rollers of an inking system for transferring the print image. Printing with printing cylinders carrying stereotypes or printing formes is relatively expensive because the printing cylinders have to be freshly set up for each new printing order.

It is therefore an object of the invention to create a method and a printing machine of the kind indicated above, but which allow printing with a printing cylinder without stereotypes or printing formes.

In accordance with one aspect of the invention there is provided a method for printing a material web which passes through between a printing cylinder and an impression cylinder, wherein dots of printing ink are produced on the printing cylinder along successive generators thereof in the zone of the roller gap formed with the impression cylinder according to the raster of the desired print image, and wherein said dots depict the rastered image to be printed on the material web.

The invention starts with the realization that rastered print images are produced from the distribution of the raster dots in the raster field of the print image, so that it is also possible to produce print images when the ink dots to be transferred are provided at the interspacings corresponding to the rastered print image on a printing cylinder in the impression zone, namely the region of the roller gap with the impression cylinder, through which gap the material web to

be printed passes along generators of the printing cylinder. Microelectronics provide miniaturized elements, by means of which it is possible to provide dots of the printing ink to be transferred for each row of the dots situated on a generator, which dots form the dots of the rastered print image to be transferred. Dots consisting of printing ink can be successively formed on the generators on the basis of computer or calculator control operations, so that these dots produce the desired rastered print image on the material web as they pass through the roller gap.

A second aspect of the invention provides a printing machine having a printing cylinder and an impression cylinder; wherein the printing cylinder is provided with bores along generators thereof, wherein the bores of each said generator and the generators themselves have an interspacing corresponding to the raster of the print image; wherein the bores communicate with one or more feed lines for printing ink, or with a chamber containing printing ink; wherein in or on the bores there are arranged microactuators consisting of micropumps or microvalves; and wherein a control unit is provided for the microactuators and is effective, depending on the angular position of the generator during rotation of the printing cylinder, either to actuate the bores to open in each case in the zone of the roller gap formed with the impression cylinder or to provide printing ink at the openings of the bores, according to a desired image to be printed.

If the microactuators consist of pumps, on its actuation each of these pumps delivers a droplet of printing ink which is then available at the opening of the corresponding bore and is taken up by the material web to be printed as it passes through the roller gap.

If the microactuators consist of microvalves, a droplet of pressurized printing ink is delivered to the opening of the bore from a reservoir by opening the respective microvalve, which droplet is then taken up by the material web.

Since the microactuators can be actuated line-wise, for example by shift registers, it is possible to produce print images according to the control operation without the use of masters such as plates or stereotypes.

The individual bores setting the raster dots of the print image need not be arranged on a common generator. They can also be disposed in each case with an offset to the generators. The only precondition is that the openings of the bores on the shell of the printing cylinder have fundamentally the same raster as the rastered print image to be printed.

The bores lead expediently into small cups which are worked into the shell of the printing cylinder. Expediently these small cups are only filled with printing ink by the microactuators when they are already covered in the zone of the roller gap by the material web passing through.

The micropumps or microvalves advantageously consist of microactuators produced according to chip technology (planar process technology). The microactuators may be integrated in a chip layer and be aligned with the bores. The chip layer may form either the printing cylinder shell itself or an intermediate layer. Microactuators consisting of micropumps and microvalves have been described, for example, in the publications of R. Zengerle and A. Richter in "Physik in unserer Zeit" [Physics in our Time], 1993, pp.86 to 90 of the in-house publication of the Fraunhofer Gesellschaft III-92 "Elektrostatisch betriebene Mikro-Membranpumpen" [Electrostatically operated micromembrane pumps] and the publication of the Fraunhofer Institute for Solid State Technology, contribution to ACTUATOR '94 "Application of Micro Diaphragm Pumps in Microfluid Systems". In these publications, the microactuators which have been described admittedly have dimensions which do not yet correspond to the raster of a print image, but it is to be expected that microelectronics or chip technology will provide smaller microactuators fitting into the print image raster in the foreseeable future.

Expediently, a microprocessor is arranged in the printing cylinder and activates the microactuators formed by the micropumps or microvalves of each line in accordance with the angular position of that line during the rotation of the cylinder, and thus controls the microactuators according to the data read out of an image memory. In addition, a further computer may be provided for communicating with the microprocessor of the printing cylinder by means of contacts produced by at least one slip ring, and for feeding the images to be printed into the microprocessor of the printing cylinder.

The printing cylinder may be formed as a hollow cylinder and contain an inking chamber communicating with the bores, to which chamber the printing ink is fed through the rotary transmission leadthrough.

By way of example an embodiment of the invention will now be described in greater detail below with reference to the drawings, in which:-

Fig. 1 shows, in a schematic representation in perspective, the printing cylinder and the impression cylinder with the material web to be printed passing therethrough;

Fig. 2 is a schematic front view showing the printing cylinder and the impression cylinder, with the printing cylinder in a sectioned schematic representation; and

Fig. 3 is a section through the printing cylinder along line III-III in Figure 2.

The printing cylinder 1 and the impression cylinder 2 are in the conventional way mounted in a machine frame, not shown. Gear wheels 3, 4 meshing with each other are keyed onto the shafts of the printing cylinder 1 and of the impression cylinder 2; one of these gear wheels meshes with a drive gear, so that both cylinders are driven at the same circumferential speed.

The printing cylinder 1 is designed as a hollow cylinder and is provided, along generators, with rows of radial bores 5 whose openings 6 lie on the cylindrical surface of the printing cylinder. In each row, the bores 5 or their openings 6 have an interspacing that corresponds to the raster of the print image. Moreover, in the circumferential direction the rows of the bores 5 or openings 6 also have an interspacing that corresponds to the raster of the print image.

In the bores 5, there are arranged microactuators 7 which may consist of micropumps or microvalves. The radial bores 5 start from a central cylindrical chamber 8 that is filled with printing ink subjected to excess pressure (with respect to ambient pressure).

As shown in Figure 1, the microactuators 7 are provided with actuating devices 9 which are controlled by an electronic control unit, preferably a microprocessor or a microcomputer, for activating the microactuators 7.

In the example of the embodiment shown in Figure 2, a microcomputer 11 with an image memory is arranged in the printing cylinder 1; this computer registers the rotational position of the printing cylinder 1 by means of an angular pulse generator 12 cooperating with the machine frame. The signals of the angular pulse generator 12 are fed to the microcomputer 11 via a line 13. The microcomputer 11 activates those microactuators that are disposed on the generator or generators passing through the roller gap. At the same time, the signals read out of the image memory are expediently passed to a shift register 10 that activates the microactuators 7 of the nozzle openings 6 printing at that instant and lying on one generator line.

The print images are fed into the microcomputer 11 by means of a computer 16 which is connected to the microcomputer 11 by means of lines 17, 18 and slip rings 19.

Printing ink is fed into the chamber 8 of the printing cylinder 1 via the rotary transmission leadthrough 20.

In the drawing only one printing unit has been schematically represented. If multicolour printing has to be executed it is possible to dispose, one after the other in the usual way, several of these printing units in accordance with the invention, which print with different printing ink colours.

The printing cylinder preferably has a circumference that is smaller than the length of the image to be printed. Since in such a printing machine the nozzle openings 6 lying on generator lines of the printing cylinder can only be activated by the microcomputer immediately before passing through the roller gap in dependence on the raster dots to be printed at that instant, the printing cylinder may be designed to be as small in diameter as desired, which is expedient because of the manufacturing costs alone.

If the printing ink is provided by microactuators in small cups of the cylindrical surface of the printing cylinder into which the microbores lead, the printing ink is taken up, because of the adhesive forces, from these small cups by the web passing through the impression gap.

CLAIMS

1. A method for printing a material web which passes through between a printing cylinder and an impression cylinder, wherein dots of printing ink are produced on the printing cylinder along successive generators thereof in the zone of the roller gap formed with the impression cylinder according to the raster of the desired print image, and wherein said dots depict the rastered image to be printed on the material web.

2. A method according to claim 1, wherein the circumference of said printing cylinder is shorter than the length of an image to be printed.

3. A printing machine having a printing cylinder and an impression cylinder; wherein the printing cylinder is provided with bores along generators thereof, wherein the bores of each said generator and the generators themselves have an interspacing corresponding to the raster of the print image; wherein the bores communicate with one or more feed lines for printing ink, or with a chamber containing printing ink; wherein in or on the bores there are arranged microactuators consisting of micropumps or microvalves; and wherein a control unit is provided for the microactuators and is effective, depending on the angular position of the generator during rotation of the printing cylinder, either to actuate the bores to open in each case in the zone of the roller gap formed with the impression cylinder or to provide printing ink at the openings of the bores, according to a desired image to be printed.

4. A printing machine according to claim 3, wherein the bores lead into small cups which are worked into the cylindrical surface of the printing cylinder.

5. A printing machine according to claim 3 or 4, wherein the micropumps or microvalves consist of microactuators fabricated according to chip technology (planar process technology).

6. A printing machine according to any one of claims 3 to 5, wherein the micropumps or microvalves are integrated in a chip layer whose microactuators are aligned with the bores.

7. A printing machine according to any one of claims 3 to 6, wherein there is arranged, in the printing cylinder, a microprocessor which activates the microactuators formed by the micropumps or microvalves of each line in accordance with the angle, and which controls the microactuators according to the data read out of an image memory.

8. A printing machine according to any one of claims 3 to 7, wherein a computer is provided which communicates with the microcomputer of the printing cylinder by means of contacts produced by a slip ring, and which feeds the images to be printed into the microcomputer.

9. A printing machine according to any one of claims 3 to 8, wherein the printing cylinder is designed as a hollow cylinder and comprises an inking chamber communicating with the bores, to which chamber the printing ink is fed via a rotary transmission leadthrough.

10. A method of printing, substantially as hereinbefore described with reference to the accompanying drawings.

11. A printing machine constructed and adapted to operate substantially as hereinbefore described with reference to, and as illustrated in, the accompanying drawings.

The Patent Office

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Application No: GB 9712419.2 **Examiner:** A.J.Rudge
Claims searched: 1-11 **Date of search:** 18 July 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): B6C(CDA,CERG,CERK,CEVS)

Int Cl (Ed.6): B41F-7/30;31/02;31/08;31/22;B41J-27/10

Other: ONLINE: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
	None	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
		E	Patent document published on or after, but with priority date earlier than, the filing date of this application.
&	Member of the same patent family		